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### (54) Metering Apparatus

(57) The invention which is the subject of this application relates to the provision of apparatus for metering the consumption of at least one of the utilities of Electricity, gas or water in a premises. The apparatus provides a means for generating a digital signal from metering apparatus which is indicative of the consumption, a first communication link for transmitting the signal to a microprocessor which generates a signal which, in turn, is transmitted via a second communications link to the utility provider or a party operating on their behalf who receives the data and can assess the same accordingly.

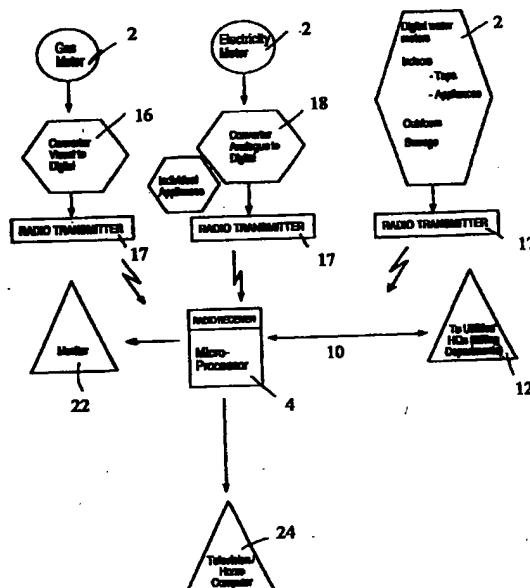


Figure 1

EP 0 834 849 A1

## Description

The present invention relates to apparatus for the measuring of usage of utility supplies such as gas, water and electricity.

At the present time each of the gas and electricity utilities in domestic premises are measured by separate metering systems and hence two separate systems are required to be installed. These systems are increasingly being joined by a third metering system for the usage of water and the plurality of systems can lead to inconvenience for the domestic customer. A further inconvenience is that each of the utility companies is required to send employees to visit the premises at regular intervals to read the meters and this is time consuming, expensive to the utility companies and inconvenient to the domestic customer.

While there are known to be systems whereby individual utility meter readings can be automatically transmitted from the premises to the utility company by radio transmission such as by the system described in application EP 0629098, these systems have not been found to be commercially successful to date and still do not address the problems of having a plurality of metering systems installed in domestic premises and nor do they allow the measurement of particular installations or appliances in the premises.

The aim of the present invention is to provide metering apparatus which allows the metering of a plurality of utilities to be combined and processed via a central unit and for the reading signals to be transmitted to the utility providers or agents representing the same. It is also a further aim of the invention to enable individual appliances and installations to be metered and the results made available to the customer.

The present invention provides apparatus for monitoring and transmitting readings indicative of the usage of any of, or any combination of, the utilities of electricity, gas and water by a consumer characterised in that said apparatus includes at least one utility metering unit, and a monitoring unit comprising a radio transmitter means for transmitting the reading value from the metering unit to a microprocessor data logger and a communication link from the microprocessor to the utility provider to transmit the reading data thereto for charging.

Typically the communication link can be either of a modem link via telephone lines or a link using cable television links. Preferably the communication link can also be utilised to send information from the utility provider to the customer. Such information could be, for example, the current tariff for the utility.

In a preferred embodiment, in addition to the primary communications link there is provided a secondary communication link between the apparatus of the customer and the utility provider.

Typically therefore the microprocessor includes a means for receiving the utility's meter reading, a modem for communication with the utility provider, a means for

calculating the amount payable by the customer, a memory unit and a secondary communication means to the utility provider.

In one embodiment the microprocessor is additionally connected to any of, a display means to allow the readings information to be displayed to the customer along with the tariff, and the amount payable, or a home computer to allow the readings obtained to be analysed and compared, for example, with previous readings, to enable user trends to be compiled.

A further important feature of the apparatus according to the invention is that a plurality of utilities metering apparatus can be incorporated into the apparatus, each typically provided with a radio transmitter, such that there is provided an integrated system whereby gas and electricity, water and electricity, gas and water, or gas, electricity and water together can all be linked into the microprocessor and communication links to provide an integrated system.

When the gas utility is to be measured and a conventional mechanical gas meter is to be used a means is provided to convert the reading to a digital form such as, for example, by a visual conversion method.

When the electricity utility is to be measured and a conventional electricity meter is to be used a means is provided to convert the reading from an analogue to digital form.

In one embodiment additional metering devices can be fitted to specific appliances to provide more detailed information which can be compiled and analysed via the microprocessor.

When the water utility is to be measured it is preferred that a non intrusive measuring apparatus be used such as, for example, ultra sonic measuring techniques or magnetic water flow measuring techniques to produce digital readings and an individual meter or a plurality of meters located around pipes for taps, appliances, sewers and suchlike are provided.

In whichever format each meter provided will, in one embodiment, have a radio transmitter for the transmission of the digital readings to the microprocessor. In one embodiment a suitable frequency is 418MHz and will be provided to operate under MPT1340 licence conditions.

Once the reading signals have been received at the microprocessor they can then be transmitted via a communication link to a remote party acting on behalf of all of the utility providers or alternatively readings can be sent directly to each of the utility providers as appropriate.

It is envisaged that the apparatus so described is of particular use for installation in domestic premises.

Specific embodiments of the invention will now be described with reference to the accompanying diagrams wherein;

Figure 1 illustrates a schematic diagram of the apparatus of the invention in one embodiment;

Figure 2 illustrates a schematic diagram of the microprocessor of Figure 1;

Figure 3 illustrates a schematic diagram of the apparatus and connection therebetween for one utility;

Figure 4 illustrates one premises monitoring system according to the invention; and

Figures 5A-C illustrate the display of data which can be provided to the consumer in the premises.

Referring to the Figures there is shown apparatus for allowing the utilities of gas, electricity and water consumed, typically in a domestic premises, to be measured and the readings transmitted to the utility provider and also analysed by the customer.

Referring firstly to Figure 3 each utility measurement apparatus includes a meter 2 to measure the consumption of the utility, said meter is connected via a first communications link including a radio transmitter for sending the reading to a microprocessor 4 which includes a means 6 for receiving the reading, a means 7 for calculating the amount of the utility used since the previous reading by referring to a memory unit 8 which holds the previous data. A second communications link 10 is provided for sending the reading to the remote utility provider 12 and receiving tariff information from the provider and there is also preferably provided a further back up or auxiliary communication link 14. Both the second and auxiliary communication links include a modem which facilitates the transfer of the data.

Figures 1 and 2 illustrate one embodiment of the apparatus according to the invention for reading gas, electricity and water utilities in combination. In the first instance means are required 16, 18 for converting conventional readings into digital form, however it is preferred that the metering apparatus used be provided to generate digital signals without the need for converting apparatus. The readings are transmitted to the microprocessor 4 having the features described in relation to Figure 3 and as set out in Figure 2 via radio transmitters 17 provided as integral parts of the metering apparatus.

In addition to the links to the utility provider the microprocessor 4 can also be linked to a display means in the form of a monitor 22 and/or personal computer 24 to allow the customer to assess the usage of the utilities and analyse and record their usage and calculate costs.

Where individual appliances are fitted with meters the ability of the customer to analyse usage is of particular interest.

Thus the apparatus according to the present invention allows an efficient utility metering service to be provided with the readings directly transmitted to the remote utility provider or an agency operating the apparatus and system on their behalf. Furthermore the appa-

ratus allows the customer to analyse their usage of the utilities and to maintain their own records on their usage if they so desire.

Figures 4 and 5A-C illustrate further embodiments of the apparatus wherein the Figure 4 illustrates a system including the apparatus of the invention and which includes digital meters 50, 52, 54 for metering consumption of gas, electricity and water. Each of the meters is provided with a radio transmitter 56 for transmitting signals data indicative of the consumption to a microprocessor 58 which includes a low power radio receiver 60, processor 62, modem 64 and display means in the form of monitor 66. The microprocessor allows the analysis of the data received and the transfer of the processed utility data to a remote utility provider or providers centralised data processing station 68 by telephone, radio satellite, power carrier or any other suitable communications link 70.

In addition to receiving data for utility usage the microprocessor can also be adapted to receive data relating to climate conditions in the premises 72, security signals and the like 74 and can allow the alteration of these conditions according to preset parameters.

The microprocessor also allows the connection of a display means such as television 76 which allows the data received by the microprocessor to be displayed to the utility consumer at their premises. Figure 5A-5C illustrate embodiments of the displays which can be generated with said figures relating to displays for electricity, gas and water respectively and with the displays selected by pressing the appropriate button 80 on or to the side of the screen. Typically the wording on the screen will not be abbreviated so as to improve the clarity of operation of the apparatus to persons who may not be computer literate.

Thus in one aspect of the invention there is provided a modular monitoring system which can include a digital water meter (clamp-on ultrasonic transit-time technique) with radio transmitter, a digital gas meter with radio transmitter, a digital electricity meter with radio transmitter and a central monitoring unit which can comprise of four main components, namely a low power radio receiving mean, a microprocessor typically including a logger on a printed circuit, a display unit for displaying the data received and a Modem to allow the communication of the processed data to the remote utility provider.

Additional modular elements can include, Security monitoring and activating system for intruder alarm and movement sensors, a remote switching of electricity / gas / water mains and appliances throughout the property, connection to the customer's personal computer system for data storage and analysis and temperature control throughout the property.

It is envisaged that the display unit will be a back lit LCD display unit using 256X128 CCFL, using 5X7 characters which enables 16 lines of 30 characters. The size of the control unit is determined by the size of the dis-

play screen which preferably should form one face of the unit. The provision of the first communication link in the form of low power radio transmission and receiving apparatus allows wireless communications using AM modulated transmitters, and receivers operating at 418 or 184 MHz and operating under MPT1340 licence conditions. It is envisaged that the modem used will be a PSTN Communication using high speed modem; typically using full featured 14400 modem.

The microprocessor will comprise a core in the form of a microcontroller which has sufficient ROM (32k) and RAM (2K) internal to itself to support the system requirements. The device may have 2 RS232 ports which would be dedicated to (a) data collection - wireless communications and (b) data despatch - modem/PC. There are numerous I/O lines which would be used in the interface to the Keypad and the display. A separate unit would be required as an interface to the TV display unit. A separate transceiver could be designed as a simple wireless connection to a PC as the unit may not be located conveniently for connection to the RS232 port. The local RS232 port is most likely to be used by the installation/maintenance engineer should be required on-site. The modem connection also allows the possibility of remote configuration/diagnostics/updates.

Thus there is provided apparatus for metering, analysing and processing data related to the consumption of utilities which does not require the attendance of persons to the premises to take readings and allows the remote reading and transmission of signals to and from the apparatus by the remote utility provider. It also allows for the monitoring and control of other conditions within the premises.

#### Claims

1. Apparatus for monitoring and transmitting readings indicative of the usage of any of, or any combination of, the utilities of electricity, gas and water by a consumer characterised in that said apparatus includes at least one utility consumption metering unit and monitoring means comprising a first communication link for transmitting the data relating to the utility consumption from the metering unit to a microprocessor data logger and a second communication link from the microprocessor to the utility provider to transmit the reading data thereto.
2. Apparatus according to claim 1 characterised in that the first communication link is a radio signal transmitting means.
3. Apparatus according to claim 1 characterised in that the second communications link is either of a modem link via telephone lines or a link using cable television links.
4. Apparatus according to claim 1 characterised in that the second communication link is used to send information from the utility provider to the customer.
5. Apparatus according to claim 1 characterised in that the microprocessor includes means for receiving the utility reading from the meter, a means for sending data indicative of the utility reading to the utility provider, a processing means for analysing and adapting the signal indicative of the meter reading prior to sending to the utility provider.
6. Apparatus according to claim 5 characterised in that the microprocessor is additionally connected to any, or any combination, of, a display means to allow the data information to be displayed to the consumer, a personal computer and can be provided to allow analysis and comparison of the received data by the consumer at the premises.
7. Apparatus according to claim 1 characterised in that a plurality of utilities metering apparatus can be incorporated into the apparatus such that there is provided an integrated system whereby gas and electricity, water and electricity, gas and water, or gas, electricity and water together can all be linked into the microprocessor and second communication link.
8. Apparatus according to claim 1 characterised in that digital metering apparatus is used for each of the utilities to generate digital data indicative of the utility consumption.
9. Apparatus according to claim 1 characterised in that the utility metering apparatus and first communications link signal generator are housed as an integral unit.
10. Apparatus according to claim 1 characterised in that gas is the utility to be measured and a conventional mechanical gas meter is used with conversion means to convert the data to a digital form.
11. Apparatus according to claim 1 characterised in that electricity is the utility to be measured and a conventional electricity meter is used with conversion means to convert the data into digital form.
12. Apparatus according to claim 1 characterised in that at least one metering device is fitted to a specific appliance to provide data relating to the consumption of the utility by that specific appliance.
13. Apparatus according to claim 1 characterised in that when the utility to be measured is water non intrusive metering apparatus is used such as, for example, ultra sonic measuring techniques or mag-

netic water flow measuring techniques to produce digital data indicative of the consumption.

14. Apparatus according to claim 13 characterised in that a plurality of meters are located around any of pipes for taps, appliances, sewers to monitor the water consumption.. 5
15. Apparatus according to claim 1 characterised in that there is provided an additional communications link between the microprocessor and the utility provider. 10
16. Apparatus according to any of the preceding claims characterised in that the apparatus further includes means for monitoring unauthorised access to the said premises and includes sensors for monitoring movement. 15
17. Apparatus according to any of the preceding claims characterised in that the apparatus includes means for automatically controlling the supply of the utility to area of the premises. 20
18. Apparatus according to any of the preceding claims characterised in that the apparatus includes means for monitoring the temperature in the premises and controlling the heating apparatus accordingly. 25

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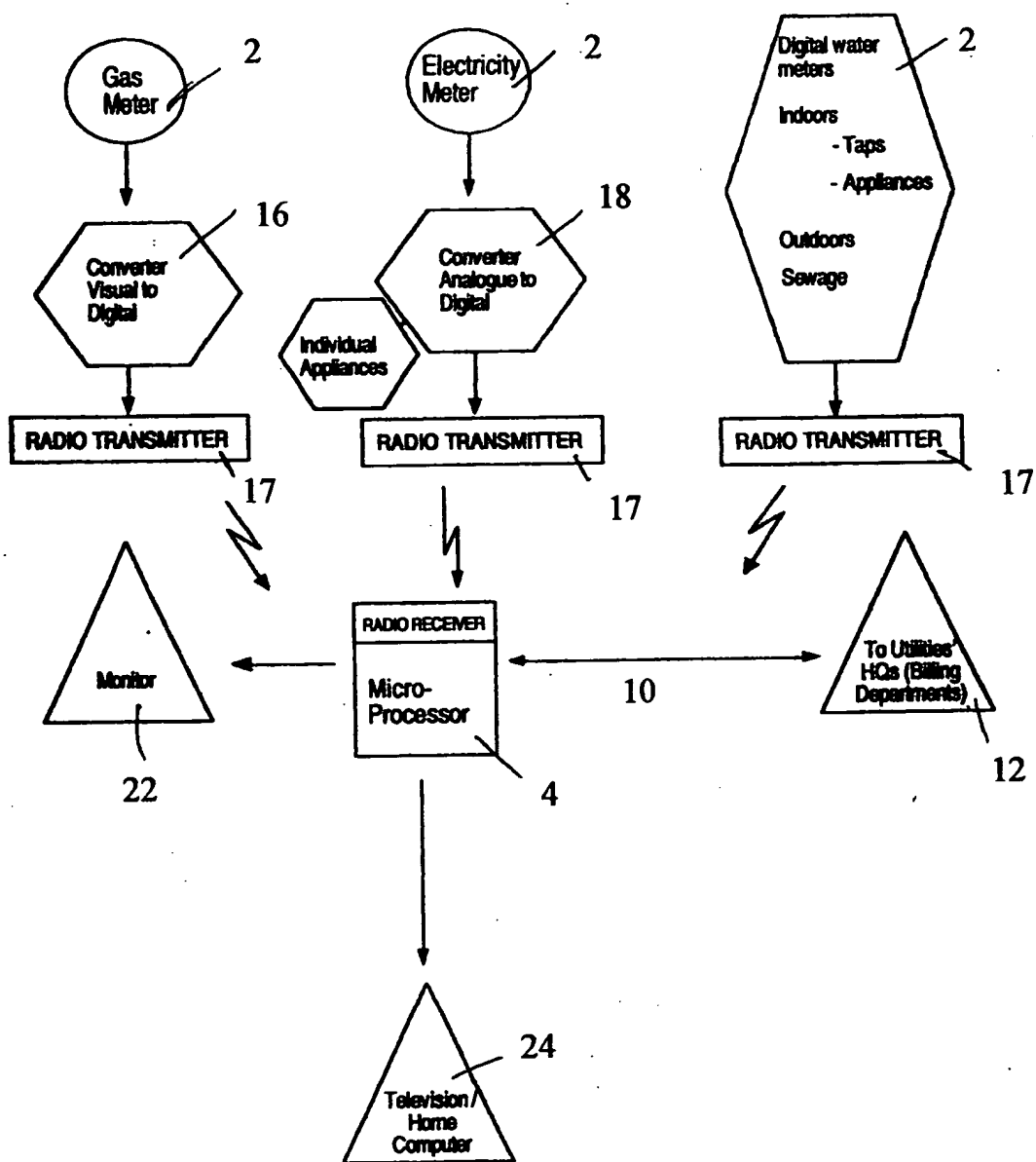
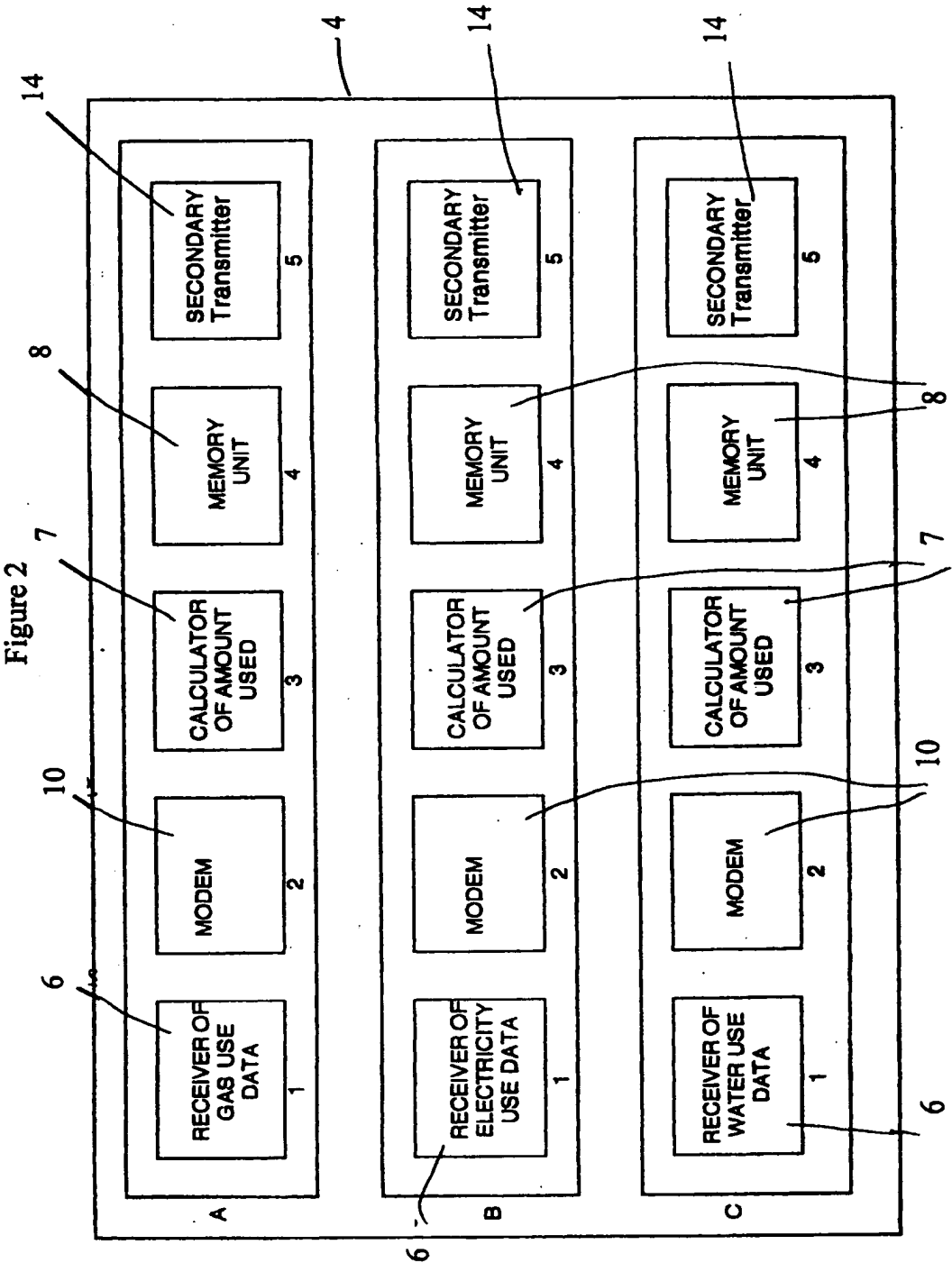


Figure 1



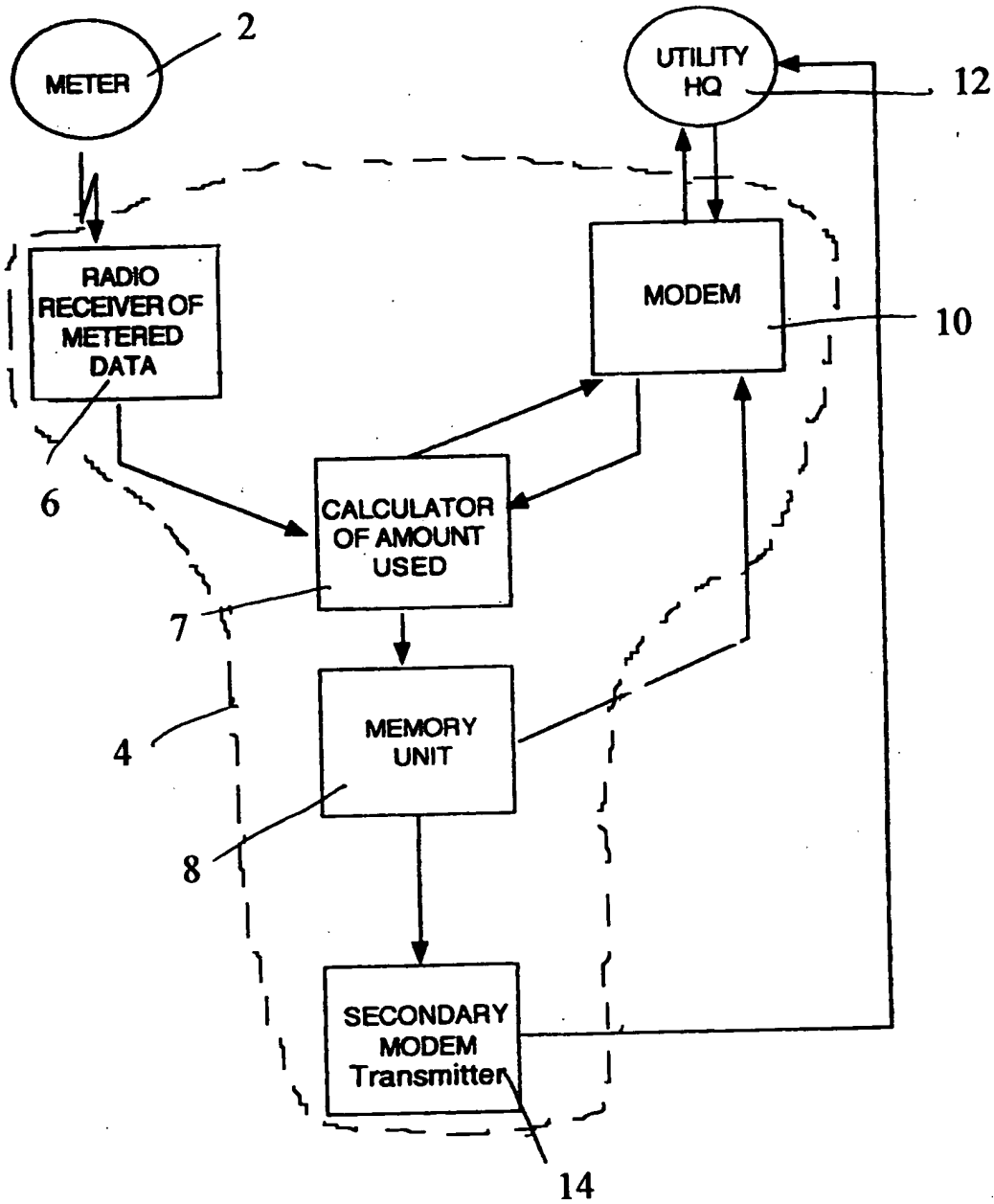


Figure 3



Figure 4

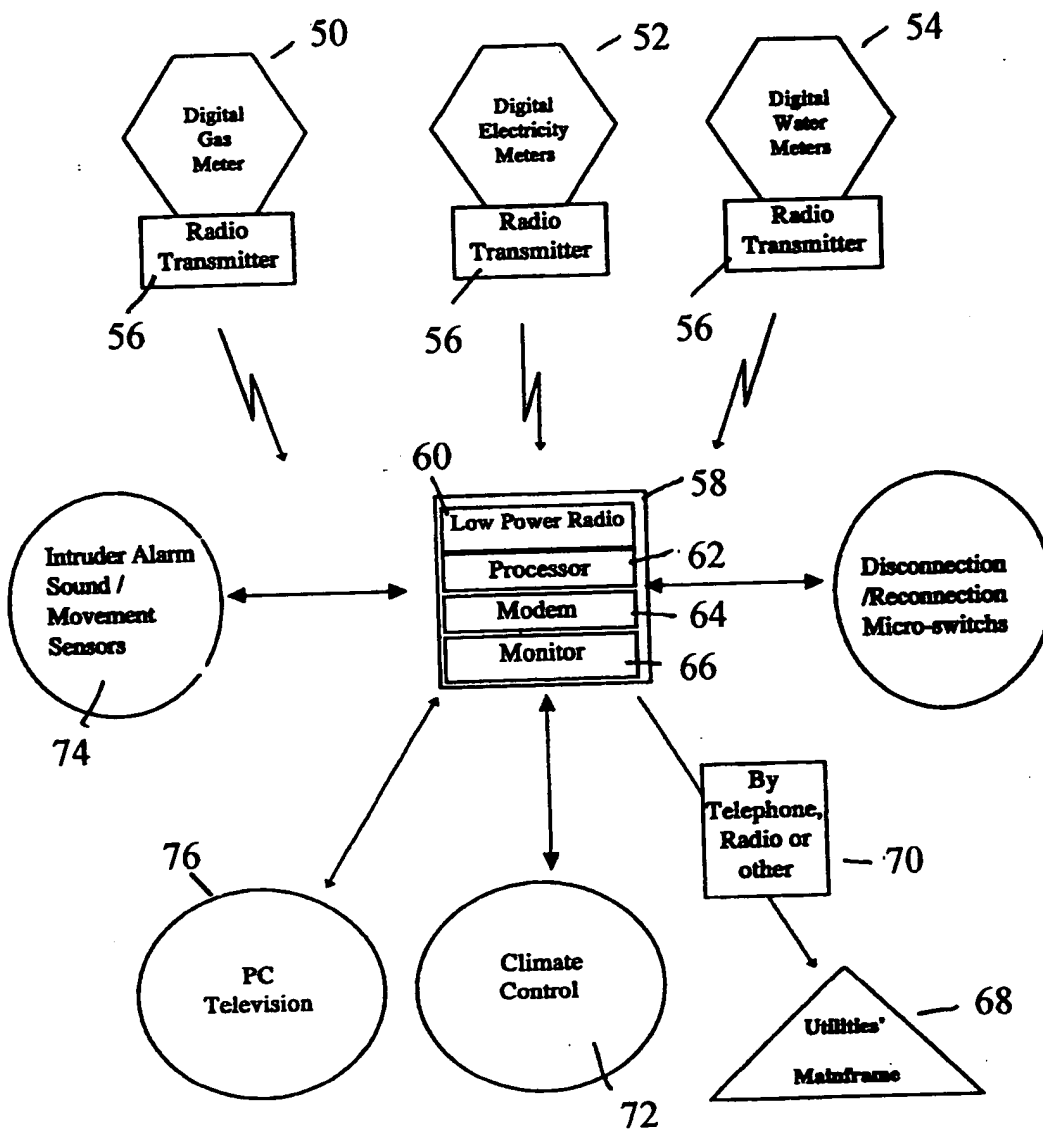


Figure 5A

UTILITY
METER NUMBER
USER NAME
TELEPHONE
OTHER NUMBER
READING NOW (kWh)
PREVIOUS CHARGED READING (kWh)
USE SINCE LAST BILL (kWh)
MODE
TARIFF 1 (PENCE PER kWh)
TARIFF 2 (PENCE PER kWh)
TARIFF 3 (PENCE PER kWh)
COST SINCE LAST BILL (£)
ANNUAL TOTAL SO FAR (£)
AVERAGE PER MONTH (£)
ESTIMATED FOR NEXT MONTH (£)
ESTIMATED FOR WHOLE YEAR (£)

Figure 5B

[illegible]

Figure 5C

UTILITY
METER NUMBER
USER NAME
TELEPHONE
OTHER NUMBER
READING NOW (M <sup>3</sup> )
PREVIOUS CHARGED READING (M <sup>3</sup> )
USE SINCE LAST BILL (M <sup>3</sup> )
MODE
TARIFF 1 (PENCE PER M <sup>3</sup> )
TARIFF 2 (PENCE PER M <sup>3</sup> )
TARIFF 3 (PENCE PER M <sup>3</sup> )
COST SINCE LAST BILL (£)
ANNUAL TOTAL SO FAR (£)
AVERAGE PER MONTH (£)
ESTIMATED FOR NEXT MONTH (£)
ESTIMATED FOR WHOLE YEAR (£)

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ELECTRICITY	GAS	USER 1	USER 2	USER 3	CHECK
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# EUROPEAN SEARCH REPORT

Application Number  
EP 97 20 2660

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (InCL6)
X	WO 95 27273 A (BELL DAVID) * page 7, line 6 - page 8, line 28; figures 1,2 *	1-3,5,7,12	G08C17/02
Y	---	4,6,9-11,16-18	
Y,D	EP 0 629 098 A (LOGICA UK LTD) * page 4, column 6, line 6 - line 10; claims 1,11,13-16 *	4,17	
Y	DE 94 05 793 U (KUNDO SYSTEMTECHNIK GMBH) * claims 1,16,20 *	9	
Y	DE 43 21 037 A (DETECON GMBH) * column 2, line 12 - line 67; claims 1,7; figure 1 *	6,10,11	
Y	CH 676 398 A (LANDIS & GYR BETRIEBS AG) * page 3, column 4, line 1 - page 5, column 7, line 16; figures 1-3 *	16,18	TECHNICAL FIELDS SEARCHED (InCL6)
X	DE 42 35 187 A (METRONA WAERMESSESSER UNION) * column 2, line 67 - column 3, line 52; figure * * column 10, line 12 - line 27 *	1-3	G08C
X	WO 93 04451 A (DISYS CORP) * page 2, line 22 - page 5, line 9 * * page 7, line 13 - page 8, line 6 * * figures 1,2 * -----	1-3,8	
The present search report has been drawn up for all claims			
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>23 October 1997</b>	Examiner <b>Wanzeele, R</b>
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document</p> <p>T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons &amp;: member of the same patent family, corresponding document</p>			

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